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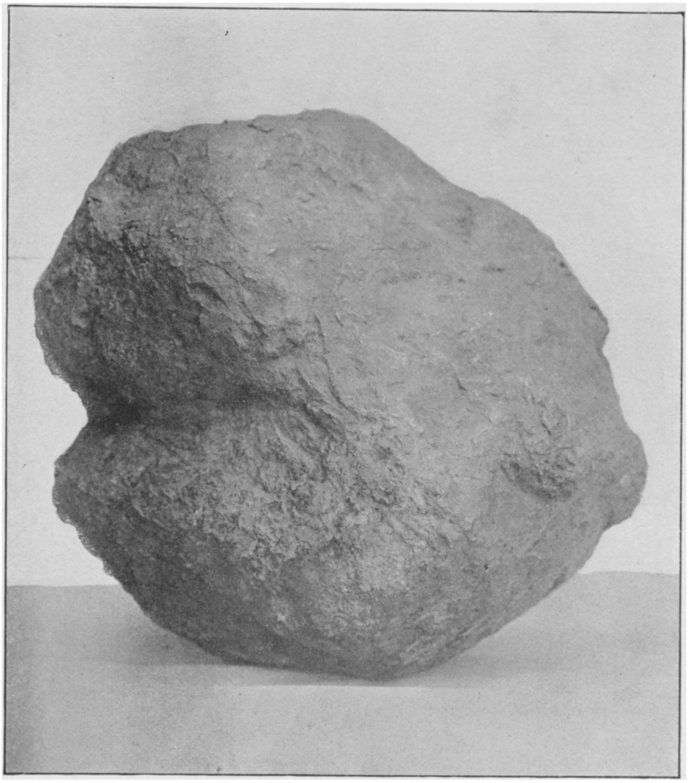

Fig. 1.
Largest Mass of the Smithville Iron.

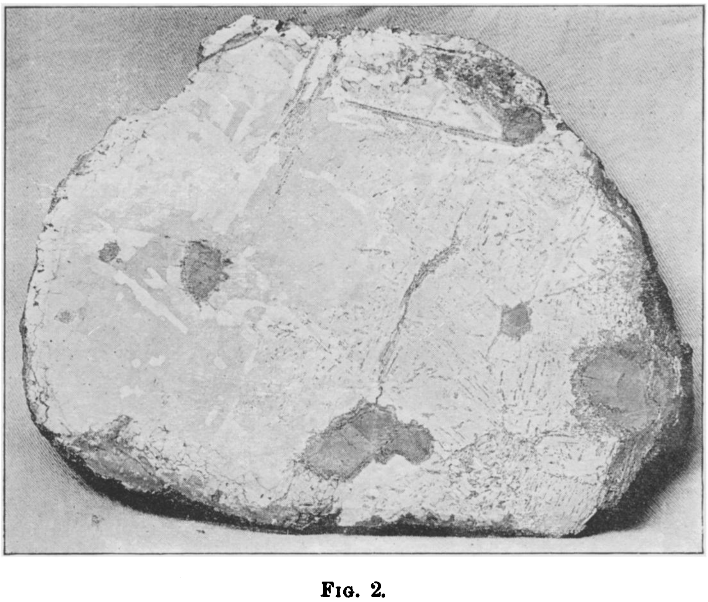

Fig. 2.
Largest Section of the Smithville Iron, Etched.
Shows at the right a nodule of graphite two inches in diameter.

XII.

CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF HARVARD COLLEGE.

THE SMITHVILLE METEORIC IRON.

By Oliver Whipple Huntington, Ph. D.

Presented February 14, 1894.

In the early part of last summer Mr. Herman Meyer sold three new masses of meteoric iron from Smithville, De Kalb County, Tennessee, to Professor Ward, of Rochester, New York. After the largest mass had been sawed into slices these were kindly sent by Professor Ward to the writer for examination, and with it was sent the following letter describing the find: —

Smithville, De Kalb Co., Tennessee.

Three siderites, weighing about seven, fifteen, and sixty-five pounds each.

In November, 1892, Mr. John D. Whaley ploughed up the medium-sized meteorite. In a few days thereafter Mr. Berry Cantrell on the adjoining farm of James Beckwith ploughed up the large one at about two hundred feet distance from the first. These meteorites were carefully kept in the families of the respective finders. During December, after diligent search of some weeks, the third meteorite and the smallest was discovered and kept in the family of J. D. Whaley. On February 25, 1893, I obtained the medium-sized meteorite, and asked for thorough search of all their fields during the spring ploughing. This was done. Several pits were dug covering nearly the entire space of three hundred feet in all directions from the spots where the siderites had been found. The ground was looked over after each rain, and I myself looked over the ground well on two occasions, and no piece was found. Only after being sure the three pieces were all that fell did I announce the meteorites to the public, which I did, after purchasing the other two, on July 12.

The spot where found is three eighths of a mile south from Smithville and Lebanon Pike, two miles from Smithville, and on extreme southwest field of J. D. Whaley and adjoining field of James Beckwith. I satisfied myself that the meteorites were original and distinct, and that all was as represented. Since in my possession they have been strictly guarded.

Herman Meyer,

August 18, 1893. *Cashier Bank of Carthage, Tennessee.*

This locality is about forty miles southeast from the spot on Cany Fork where the Carthage meteorite was found.

There is no question that the irons were found as stated in the above letter, but one familiar with the well known and widely distributed Cocke County iron could not but be struck with its close resemblance to the Smithville meteorites.

The largest mass of the Smithville iron, as shown in the plate, Figure 1, is roughly spherical, with no signs of original crust, but marked by one deep pitting which once contained troilite now nearly weathered away, or possibly melted out during the flight of the body through the atmosphere. That the specimen had lain for a long time in the soil is evident from its being coated with a thick covering of magnetic oxide of iron, the magnetism being strong enough to attract iron nails with considerable force. This covering, however, does not fully conceal certain very typical features of the iron,— a marked silvery whiteness, a very striking and ready octahedral cleavage, a slightly yellowish metallic foil separating the crystalline plates of iron, — also numerous nodules of a very cleavable troilite, embedded in graphite and granular schreiberseit; while perhaps the most striking feature of all is a nodule of fine-grained compact graphite nearly two inches in diameter. This is probably a larger mass of meteoric graphite than any on record. The only one which compares with it is that formerly described by J. Lawrence Smith in the Sevier County iron.* The weight of the Smithville nodule cannot be accurately estimated, as it was not observed till the mass had been sawed into slabs. It appeared to be nearly spherical, with a diameter as great as the longest dimension of the dumb-bell shaped nodule described by J. Lawrence Smith, making the total mass of the former considerably greater than that of the latter.

Figure 2 of the plate represents an etched surface of the largest section of the sixty-four and a half pound specimen of the Smithville iron, and here again are very striking features. The natural size of the section is nine and a quarter inches by seven. Near the lower right-hand corner can be seen, somewhat indistinctly outlined, the large nodule of graphite just described, while the rest of the plate brings out quite markedly the peculiar features of the Widmanstättian figures. In the first place, nodules of graphite and troilite are abundantly scattered over the surface. Usually these nodules are troilite embedded in graphite, and this in its turn is surrounded by schreiberseit, though there is considerable variety in the relative arrangement of these three minerals in the individual nodules. In places the schreiberseit widens out into bright patches between the Widmanstättian plates, especially in proximity to the troilite nodules.

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* American Journal of Science, 3d ser., Vol. XI. p. 392, 1876.

This inequality in the distribution of the schreiberseit gives a very varied appearance to the etched surface, and areas selected from opposite ends of the slab shown in the plate (Fig. 2) could not possibly be identified by the Widmanstättian figures alone. In this character the iron very closely resembles those of Arva and Sarepta.

Several analyses were made of the Smithville iron, though in the opinion of the writer such analyses are of very little value on account of the difficulty of sampling, since the nickel and cobalt must vary with the tænite plates, while the phosphorus would depend upon how much schreiberseit happened to be in the mixture selected for analysis. Choosing, however, as uniform material as possible, the average analysis gave: —

Iron	91.57
Nickel	7.02
Cobalt	.62
Copper	Trace
Phosphorus	.18
Residue, mainly Cliftonite	.15
	99.54

Comparing this with the irons most closely resembling it we have: —

	Greenbrier Co.,[*] West Virginia.	Jennie's Creek,[†] Wayne Co., W. Va.	Cosby's Creek,[‡] Cocke Co., Tenn.	Sevier Co.,[§] Tenn.	
Iron	91.59	91.56	87.00	93.80	94.03
Nickel	7.11	[‖] 8.31	[‖] 12.00	4.66	4.44
Cobalt	.60				
Copper	Trace				
Phosphorus	.08	.13			
Carbon	—	—	.50		
Residue	.12				
Loss	—	—	.50	.10	.10
	99.50	100.00	100.00	98.56	98.57

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[*] Mineralogical Magazine, Vol. VII. p. 183, 1887.

[†] American Journal of Science, 3d ser., Vol. XXXI. p. 145, 1886.

[‡] Ibid., 1st ser., Vol. XXXVIII. p. 250, 1840; Ibid., 1st ser., Vol. XLIII. p. 354, 1842.

[§] Ibid., 2d ser., Vol. IV. p. 83, 1847.

[‖] By difference.

No analyses have been made of the meteorites of Waldron's Ridge,* Claiborne Co., and Lebanon,† Wilson Co., Tennessee, but they are generally accepted as identical with the Cocke County iron.

Of the above analyses the Greenbrier County is probably the most reliable, and this it will be seen is almost identical with the Smithville. The analysis of Jennie's Creek is of very little account, since it consists of a determination of the percentage of the iron alone, the balance in weight being set down as nickel and cobalt, while the analyses of the Cocke County and Sevier County, unquestionably the same iron, differ widely from each other.

In marked contrast to this variation is a collection of analyses placed in comparison by Fletcher, when describing the Greenbrier County specimen now in the British Museum.‡

	Greenbrier Co.	Trenton. (L. Smith.)	Rio Juncal. (Damour.)	Seneca River. (Shepard.)	Staunton. (Santos.)
Iron	91.59	91.03	92.03	92.12	91.44
Nickel	7.11	7.20	7.00	7.54	7.56
Cobalt	0.60	0.53	0.62		0.61
Copper	Trace	Trace			0.02
Phosphorus	0.08	0.14	0.21	0.08	0.07
Sulphur	Trace				0.02
Residue	0.12	0.45		0.26	0.14
	99.50	99.35	99.86	100.00	99.86

On glancing at the above table one would suppose that it exhibited parallel analyses of the same iron, whereas they are actually irons so widely separated by their physical characters as well as by their geographical distribution that in our present knowledge of the subject we are forced to regard the resemblance of the chemical analyses as an accidental coincidence.

Although a mere chemical analysis seemed insufficient to identify the Smithville iron with the Cocke County, or Sevier County iron, one point in its composition seemed important. After dissolving a portion of the Smithville iron in hydrochloric acid, assisted by a battery,* a black residue was obtained, consisting mainly of small graphitic crystals, with a predominence of cubo-octahedral forms, but showing also perfect little cubes without any modifications, and others with their edges truncated by the dodecahedron, and occasionally bevelled by a very obtuse tetrakis hexahedron. This was evidently the now well known form of meteoric graphite, first seen by Haidinger in the Arva iron,† named Cliftonite by Fletcher in the Youndegin iron,‡ but also found by him in the Cocke County iron.

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* American Journal of Science, 3d ser., Vol. XXXIV. p. 475, 1887.

† Ibid., Vol. XXXIII. p. 118, 1887.

‡ Mineralogical Magazine, Vol. VII. p. 183, 1887.

While examining a nodule of graphite formerly obtained by J. Lawrence Smith from the Sevier County iron, it was accidentally broken and showed in its interior what appeared to be a skeleton octahedron of graphite three eighths of an inch in diameter, and with all but one of its faces sufficiently perfect for measurement by an application goniometer. This striking feature at once suggests that this also may be a pseudomorph after diamond.

With the Cliftonite from the Smithville iron were to be seen numerous white glassy grains. On digesting the residue for a long time with hydrofluoric acid, most of the white grains disappeared, but a few remained entirely unaffected by the acid. These appeared as very brilliant transparent angular fragments, and exhibited a hardness sufficient to scratch the ruby. As only a few grains were obtained from the amount of iron placed at the disposal of the writer, no further experiments could be made, but in all probability the grains were diamond.

In a letter from Professor Ward dated October 13, 1893, he says, "The 'Smithville' seems to cut harder than any iron which we have yet undertaken"; and Fletcher says of the Youndegin iron, "The large specimen was cut on the premises of the Museum by means of hack-saws, and was found to be so hard that three weeks were required for the severance of a fragment of which the cut face is not two and a half inches square." § May not this unusual hardness be accounted for by the presence of minute diamonds?

In view of the constant occurrence of graphite in meteoric iron, and the frequent appearance of the same in the crystalline form of diamond, (the carbonaceous material apparently varying in hardness from one and a half on the usual scale to the maximum hardness in the crystals of true diamond as found by the writer in the Cañon Diablo iron,*) may it not be that all meteoric iron contains diamonds at least of the carbonado variety, only waiting for a sufficiently careful search to reveal them, and that the peculiar toughness of these irons, so imperfectly accounted for by the network of Widmanstättian plates, may be explained by the presence of the hardest substance known in a state of excessively fine division?

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* These Proceedings, Vol. XXIX. p. 204.

† Pogg. Annalen, Bd. LXVII. p. 437, 1846.

‡ Mineralogical Magazine, Vol. VII. p. 121, 1887.

§ Ibid., p. 123.

Glancing now for a moment at the accounts of the several masses of the Cocke County iron, we can see why this same iron has kept coming to light year after year ever since 1840. That it is given a different name each time is not to be wondered at, since the prices paid for meteorites by collectors puts a great premium on names.

In the first description of the Cocke County iron, in 1840, Dr. Troost says at the opening of his paper: "During my excursions through East Tennessee I had seen small fragments of native iron, and had heard of large masses of it. It being considered a precious metal, all that was known about it, and the place where it was found, were kept a profound secret." †

He then goes on to state how a few small pieces had come into his hands, and that he believed the original mass weighed two thousand pounds. He also adds that he went to Buncombe County, North Carolina, where there was said to be a great quantity of it, but found none.

Two years later Professor C. U. Shepard described a mass in the museum of the East Tennessee University at Knoxville, and quoted a letter in regard to it: —

"It is a portion of an irregular mass, which was given me about five years since. The mass, as you have been informed, was discovered in Cocke County. The proprietor resisted for some time all importunities to discover where it was; believing it to be some metal of great value. I assured his agent that it was native iron, and probably meteoric. After he became satisfied of its character, many individuals examined it, in place. It was entirely insulated on the ground, and weighed about seven or eight hundred pounds. Specimens were obtained from it and dispersed through the country.

"It was my intention to have purchased and transported the entire mass to Knoxville, until I learned that Dr. Troost, Geologist of the State, had obtained the refusal of it. He has conveyed it since to Nashville." *

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* These Proceedings, Vol. XXIX. p. 204.

† American Journal of Science, 1st ser., Vol. XXXVIII. p. 250.

Later on, Shepard quotes two letters describing the original Cocke County mass: "The large mass of meteoric iron found some years ago in Cocke County (on a creek called Cosby's) fell into the hands of some persons who tried to break it with sledge-hammers; but not succeeding, they placed it upon what is here called a 'log-heap,' where, after roasting for some time, it developed certain natural joints, of which advantage was taken with cold chisels and spikes for its separation into fragments. These were put into a mountain wagon, and transported thirty or forty miles to a sort of forge, and there hammered into 'gun-scalps,'† and other articles of more common use. Some remnants of the mass fell into the hands of Dr. Troost. The original mass was one of rare character, and ought to have been preserved entire. Much of it was composed of large and perfect octahedral crystals. Its weight was about a ton. Another mass weighing one hundred and twelve pounds was found near the locality of the larger one. This also was malleable, very white, and easily cut with a sharp instrument. It was picked up by a mountaineer, who, supposing it to be silver, asked fifteen hundred dollars for it. After retaining it for some years, he finally sold it to a friend of mine for a small sum, who transferred it to Dr. Troost."

Second letter: "The weight of the mass has been variously estimated; but I am certain it was never weighed prior to its being broken up. It was probably about two thousand pounds. In figure, it was an oblong square block. I saw several very regular octahedral crystals which had been detached from the exterior angles of the mass. I had formerly supposed that the whole of it had been taken to Lary's forge, in Sevier County, and the greater part of it there wrought into 'gun-scalps'; but very recently I have been informed that part of it was taken to the forge of Peter Brown, in Green County, and there forged. I understand that a man by the name of McCoy had a neat bar forged from it for making a gun-barrel, which, to use the expression of Brown's son, "was as bright as silver." In conversation young Brown informed me that he thought a piece of the iron in its natural state still remained. On searching, it was found by a little girl of the

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* American Journal of Science, 1st ser., Vol. XLIII. p. 354, 1842.

† The forged iron bar before being bored for a gun barrel is called in Tennessee a "gun-scalp."

family. It weighs rather more than a pound, and had been preserved by the family as a nut-cracker." *

About the year 1880, a fragment of iron, said to weigh eleven pounds, was found in Greenbrier County, West Virginia, in regard to which Fletcher says: "The finder and his official agent, thinking it a piece of rich iron ore, searched unsuccessfully for a vein: the specimen itself was taken to a country smith's shop, heated, and cut with a cold chisel; the fragments were distributed as specimens of iron ore. Some time afterwards, two of them, weighing respectively 63 oz. and 31 oz., were given by the agent to Mr. Matthew A. Miller, Civil Engineer, of Richmond, Virginia; convinced of their meteoric origin, he immediately tried to recover the pieces already distributed, but after travelling several hundred miles was forced to the conclusion that they were irrecoverably lost." †

Later still Mr. George F. Kunz describes three small pieces from Wayne County, West Virginia, the largest of the three only weighing a little over half a pound, the rest of the original mass having been broken up and distributed.‡ The Wayne County specimens were sent to the writer by Mr. Kunz before being described, and were identified at once as more of the Cocke County iron. In connection with this iron a supposed fall of a meteorite in the direction of Wayne County some five years previous was quoted, but any one familiar with meteorites knows how frequently such accounts have to be rejected, even when the observer thinks the specimen fell at his feet, and that he picked it up while still too hot to hold.

Another piece of the Cocke County iron was given to Professor N. S. Shaler in 1887, purporting to be a sample of a vein of native iron of indefinite extent, near Lebanon, Wilson County, Tennessee. It may be that this fragment was originally broken off from the Smithville irons and that they were the iron vein referred to, since they were found not far from the Lebanon Turnpike, though in the adjacent county.

The map on the opposite page, drawn to scale, will give an idea of the distribution of the counties in which the various irons under discussion were found.

At first one might be led to suppose that these numerous masses of iron resulted from a wide-spread shower, but on looking over the

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* American Journal of Science, 2d ser., Vol. IV. p. 84, 1847.

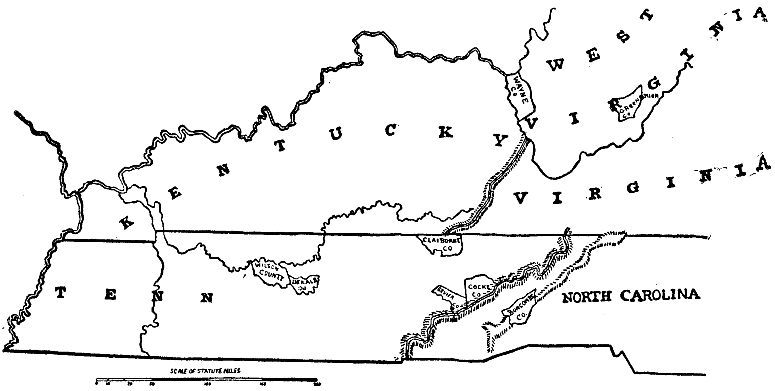
† Mineralogical Magazine, Vol. VII. p. 183, 1887.

‡ American Journal, 3d ser., Vol. XXXI. p. 146, 1886.

records it is obvious that portions of the original mass from Cocke County were distributed far and wide; and since only small portions have found their way into museums, it is not surprising that they have been turning up so frequently.

Thus we have: —

	Reported Weight.	Collected.
Cocke County	2,000 lbs.	A few small pieces.
Sevier County	112 "	112 lbs.
Wayne County	27 "	2 "
Greenbrier County	11 "	Less than 6 "
Wilson County	1½ "	1½ "
Waldron's Ridge, Tazewell County	18 "	18 "



Thus we see that about a ton of this iron is still missing, and, though some of it has been used up at a blacksmith's forge, other pieces are known to have been deliberately buried and dug up again to sell as samples of iron or silver mines, while others still have been carried to long distances, treasured by the owners as silver or some other metal of value, and this has been going on for more than fifty years.

At this late date, therefore, it is impossible to form any conclusion in regard to the original distribution of the irons under discussion, or to determine whether only one mass originally fell, or whether there was a large shower, spreading over a considerable area, as in the case of the Cañon Diablo meteorite recently studied.

That in several cases specimens in our cabinets under different names came from this original Cocke County mass is more than probable, but it may well be that in other cases the identity of characters only indicates that the several masses were parts of the same meteoric shower. The multiplication of unnecessary names is unfortunate, and for the simplicity of our catalogue it is desirable that such questions as the present should be investigated.

In conclusion, the writer wishes to thank Professor H. A. Ward, of Rochester, New York, for his kindness in having the plates made with which this paper is illustrated, and for his extreme courtesy in furnishing material for analysis, as well as sending for inspection the large mass sawed into slabs.